

CLAIMS

1. A composite rare-earth anisotropic bonded magnet, comprising:

(A) 50 to 84 mass% of R1FeB coarse powder, comprising:

1. R1FeB anisotropic magnet powder with an average grain diameter of 50 to 400 μm , obtained by performing a hydrogenation treatment on an R1FeB alloy having a rare earth element including yttrium (Y) (hereafter, "R1"), iron (Fe), and boron (B) as its main ingredients; and

2. #1 surfactant that coats the surface of the constituent grains of the said R1FeB anisotropic magnet powder; and

(B) 15 to 40 mass% of R2Fe(N, B) fine powder, comprising:

1. R2Fe(N, B) anisotropic magnet powder with an average grain diameter of 1 to 10 μm , having a rare-earth element including Y (hereafter, "R2"), Fe, and nitrogen (N) or B as its main ingredients; and

2. #2 surfactant that coats the surface of the constituent grains of the said R2Fe(N, B) anisotropic magnet powder; and

(C) 1 to 10 mass% of a resin as binder;

this bonded magnet having the special features that maximum energy product $(\text{BH})_{\text{max}}$ is 167 to 223 kJ/m^3 , and permanent flux loss, which indicates the proportion of magnetic flux loss which can be obtained with remagnetizing after the passage of 1000

hours at 100 °C, is 6% or less.

2. The composite rare-earth anisotropic bonded magnet recited in claim 1, wherein at least one of the above R1FeB anisotropic magnet powder or above R2Fe(N, B) anisotropic magnet powder includes 0.05 to 5 at% of one or more of the rare-earth elements (hereafter, "R3") consisting of dysprosium (Dy), terbium (Tb), neodymium (Nd), and praseodymium (Pr), when taking the whole as 100 at%.

3. The composite rare-earth anisotropic bonded magnet recited in claim 1, wherein at least one of the above R1FeB anisotropic magnet powder or above R2Fe(N, B) anisotropic magnet powder includes 0.01 to 1 at% of lanthanum (La), when taking the whole as 100 at%.

4. A composite rare-earth anisotropic bonded magnet production method comprising:

(1) A heat orientation process in which a mixture comprising:

(A) 50 to 84 mass% of R1FeB coarse powder, comprising R1FeB anisotropic magnet powder with an average grain diameter of 50 to 400 µm, obtained by performing a hydrogenation treatment on an R1FeB alloy having R1, Fe, and B as its main ingredients, the surface of the constituent grains of R1FeB anisotropic magnet powder being coated with a #1 surfactant; and

(B) 15 to 40 mass% of R2Fe(N, B) fine powder,

comprising

R₂Fe(N, B) anisotropic magnet powder with an average grain diameter of 1 to 10 µm, having R₂, Fe, and N or B as its main ingredients, the surface of the constituent grains of R₂Fe(N, B) anisotropic magnet powder being coated with a #2 surfactant; and

(C) 1 to 10 mass% of a resin as binder

is heated to a temperature above the softening point of the said resin, and while keeping that resin in a softened state or melted state, an orienting magnetic field is applied so that the R₁FeB coarse powder and R₂Fe(N, B) fine powder are oriented; and

(2) A molding process in which, after the said heat orientation process, the mixture is heated and press molded;

this production method having the special feature that a composite rare-earth anisotropic bonded magnet is obtained in which the said R₂Fe(N, B) fine powder and said resin are evenly filled into the gaps between constituent grains of the said R₁FeB coarse powder.

5. The composite rare-earth anisotropic bonded magnet production method recited in claim 4, wherein the said mixture is comprised of a compound in which the surface of the constituent grains of the said R₁FeB coarse powder is coated by a coating layer in which the said R₂Fe(N, B) fine powder is evenly dispersed in the said resin.

6. The composite rare-earth anisotropic bonded magnet compound production method recited in claim 5, wherein the above compound is obtained after a heat kneading process in which the above R1FeB coarse powder, above R2Fe(N, B) fine powder, and above resin are heat kneaded at a temperature above the softening point of the said resin.

7. The composite rare-earth anisotropic bonded magnet production method recited in claim 5, wherein the above mixture is comprised of a preparative compact in which the said compound is filled into the cavity of the molding die and then press molded.

8. The composite rare-earth anisotropic bonded magnet production method recited in claim 4, wherein the above resin is thermosetting resin, and the above heat orientation process is performed heating at a temperature above the hardening point of the said thermosetting resin.

9. A composite rare-earth anisotropic bonded magnet compound comprising:

(A) 50 to 84 mass% of R1FeB coarse powder, comprising:

1. R1FeB anisotropic magnet powder with an average grain diameter of 50 to 400 μm , obtained by performing a hydrogenation treatment on an R1FeB alloy having R1, Fe, and B as its main ingredients; and

2. #1 surfactant that coats the surface of the constituent grains of the said R1FeB anisotropic magnet powder; and

(B) 15 to 40 mass% of R₂Fe(N, B) fine powder, comprising:

1. R₂Fe(N, B) anisotropic magnet powder with an average grain diameter of 1 to 10 µm, having R₂, Fe, and N or B as its main ingredients; and

2. #2 surfactant that coats the surface of the constituent grains of the said R₂Fe(N, B) anisotropic magnet powder; and

(C) 1 to 10 mass% of a resin as binder;

this bonded magnet compound having the special feature that the surface of the constituent grains of the above R₁FeB coarse powder is coated by a coating layer in which the above R₂Fe(N, B) fine powder is evenly dispersed in the above resin.

10. The composite rare-earth anisotropic bonded magnet compound recited in claim 9, wherein the relative density of the bonded magnet obtained when performing magnetic field heat molding under conditions of molding temperature 150 °C, magnetic field 2.0MA/m, molding pressure 392MPa is 92 to 99%.

11. The composite rare-earth anisotropic bonded magnet compound recited in claim 9, wherein at least one of the above R₁FeB anisotropic magnet powder or above R₂Fe(N, B) anisotropic magnet powder includes 0.05 to 5 at% of one or more of the rare-earth elements (R₃) consisting of Dy, Tb, Nd, and Pr, when taking the whole as 100 at% .

12. The composite rare-earth anisotropic bonded magnet recited in claim 9, wherein at least one of the above R₁FeB anisotropic magnet powder or above R₂Fe(N, B) anisotropic

magnet powder includes 0.01 to 1 at% of lanthanum (La), when taking the whole of each as 100 at%.

13. A composite rare-earth anisotropic bonded magnet compound production method comprising:

(1) A mixing process which mixes:

(A) 50 to 84 mass% of R1FeB coarse powder, comprising

R1FeB anisotropic magnet powder with an average grain diameter of 50 to 400 μm , obtained by performing a hydrogenation treatment on an R1FeB alloy having R1, Fe, and B as its main ingredients, the surface of the constituent grains of R1FeB anisotropic magnet powder being coated with a #1 surfactant; and

(B) 15 to 40 mass% of R2Fe(N, B) fine powder, comprising

R2Fe(N, B) anisotropic magnet powder with an average grain diameter of 1 to 10 μm , having R2, Fe, and N or B as its main ingredients, the surface of the constituent grains of R2Fe(N, B) anisotropic magnet powder being coated with a #2 surfactant; and

(C) 1 to 10 mass% of a resin as binder; and

(2) A heat kneading process in which, the mixture obtained after the said mixing process is heat kneaded at a temperature above the softening point of the said resin;

this production method having the special feature that it obtains a compound in which the surface of the constituent grains of the above R₁FeB coarse powder is coated by a coating layer in which the above R₂Fe(N, B) fine powder is evenly dispersed in the above resin.

14. A composite rare-earth anisotropic bonded magnet with the special feature that it is obtained by the composite rare-earth anisotropic bonded magnet production method recited in any of claims 4 through 8.

15. A composite rare-earth anisotropic bonded magnet compound with the special feature that it is obtained by the composite rare-earth anisotropic bonded magnet compound production method recited in claims 13.